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paper is completely coated, the insulation material may be separated from excess chemicals. Any excess may then be recycled and used in another coating step.

Continuous in-line mixers of the type commercially available may also be used and the fire retardant agent metered.

With the coating step completed, it is necessary to put the insulation material into containers in order to store, transport and use it. The material is thus transferred from the mixing bin through a auger type conveyer which moves the material to an opening at which a bag is attached. The manner in which the insulation material is bagged is dependent upon the particular application for which the material is intended.

The present invention provides for two applications for this shredded paper insulation. The first application, which up until the present invention has been the only application for all shredded paper insulation, is to use the material as a loose-fill insulation material in completed structures. For loose-fill applications, conventional bagging will suffice. In order to use the insulation material as loose-fill, it is merely necessary to open the bag and blow or pour the material into the spaces that need to be insulated. The phosphorous-containing compositions in the present invention do not corrode the internal metal elements in the walls. In fact, a phosphatizing reaction may occur in which protective films are formed on the metal surfaces.

The second application for the insulation material of the present invention is as insulative batting as shown in FIG. 1.

Insulative batting is useful in the same manner as fiberglass batting for insulating buildings under construction. The insulative batting 1 is formed at the bagging step by providing an elongated plastic envelope 6 into which the flame retardant shredded paper insulation material 7 is filled.

The plastic envelope 6 has two lateral flanges 2 which are used to attach the insulative batting to studding 3 by means of staples, tacks or nails 4. Air is drawn from the envelope 6 during manufacture through orifice 5 to facilitate transportation, storage and installation of the batting. Once operably positioned, the plastic envelope 6 is puntured allowing the reentry of air and causing the insulation material 7 and the plastic envelope 6 to expand tightly in the space between the studs 3. In addition to enveloping the shredded paper insulation material 7, the elongated plastic envelope 6 also presents a vapor barrier.

In a similar manner, an air impervious sack may be filled with the completed insulation and have air pumped from it. This will compress the sack and its contents into a package having a considerably smaller volume which will represent on the order of a 50% or more reduction in volume.

Subsequent opening or puncturing of the sack will initiate the expansion of the insulation back to its original density for use.

The following examples are given to further illustrate the present invention, but it should be understood that the invention is not to be limited in any way by the details described therein.

EXAMPLE 1

Shredded paper was produced by hand using a kitchen hand grater with diagonal projections spaced ½ inch apart. Starting with fine, powdered calcium orthophosphate [$Ca(H_2PO_4)_2$] combined with urea in a proportion of 1.5 parts by weight of urea to 1 part by weight of the calcium orthophosphate, the chemical mixture was ground to a talcum powder consistency using a mortar and pestle with 100 circular strokes. Had the original phosphate-containing compound been of a greater particle size, more grinding would have been necessary. The chemical composition was added to the shredded paper by kneading the chemical and the shredded paper in an alumium tray for three minutes until the powder was well distributed over the surface of the shredded paper. The coated shredded paper was then hand sifted in a one quart sifter by shaking to remove the excess powder. A mound of the coated shredded paper was formed in a 1 inch high, four-sided pyramidal shape. A book match was lit and held along one side of the shredded paper mound for 10 seconds and was then removed. The time for flame extinquishment was recorded as well as the time of punking if any punking was present.

In the first test, using material produced in the above manner, immediate extinquishment of the flame occurred with no subsequent punking. A second test using the same material showed a 4 second time of extinquishment of the flame with no subsequent punking.

A control experiment was run using commercially available shredded paper insulation coated with a borax/boric acid flame retardant composition. The mound was identically shaped and the ignition time was again 10 seconds. In the first test of the control a 7 second time of extinquishment of the flame was observed with no subsequent punking. In a second test using the same control material, a 5 second time of extinquishment was observed with no subsequent punking. The control insulation material was listed as complying with all major federal specifications for flame retardant paper insulation in addition to complying with the American Society for Testing and Materials standards for cellulosic loose-fill thermal insulation.

EXAMPLE TWO

The same procedure used to produce and test insulation material in Example 1 was followed except for the substitution of mono-hydrogen ammonium orthophosphate [$(NH_4)_2HPO_4$] for the mono-calcium orthophosphate used in Example 1. In addition, two parts of urea were used to one part of the mono-hydrogen ammonium orthophosphate. A three to five second time of extinquishment of the flame was observed with no subsequent punking.

EXAMPLE THREE

The same procedure was followed in Examples 1 and 2, except that mono-hydrogen ammonium orthophosphate [$(NH_4)_2HPO_4$] was used alone. The time of extinquishment of the flame was observed to be approximately six seconds with no subsequent punking. In this Example there was more flame initially than in Example 2. The quantity of flame was comparable to the control shredded paper insulation used in Example 1. This result suggests a synergistic effect between nitrogen-containing compounds and phosphorous-containing flame retardant compounds. The evolution of nitrogen-containing compounds such as ammonia tends to subdue the flame while phosphoric acid changes the course of the decomposition reaction of cellulose on heating.

EXAMPLE FOUR

An experiment was conducted to determine the change in flame retardancy of two commercially available shredded paper insulation materials and the insulation material of the present invention when heated in a dry atmosphere. One of the commercially available insulation materials was previously described and used as a control material in Example 1. The second insulation material was a commercial preparation believed to contain a three to two to one weight ratio of ammonium sulphate to borax to boric acid at a loading of approximately 20% by weight of chemical to paper. The shredded paper insulation of the present invention was prepared as described in Example 1 using a mixture of the urea and calcium orthophosphate mono-hydrate in a ratio of 1.5 parts by weight urea to 1 part by weight calcium orthophosphate mono-hydrate.

Approximately 5 grams of each of the three samples of shredded paper insulation were placed on an aluminum pan and heated in an oven to 200° F. for two hours. At the close of the two hour period, the three samples were removed from the oven and allowed to cool to room temperature for 10 minutes. Each of the three samples were then ignited by placing a flaming book match in the center of the 5 grams of insulation.

The commercial insulation material believed to contain a three to two to one weight ratio of ammonium sulphate to borax to boric acid was observed to flare badly thereby charring approximately 90% of the surface of the experimental mound. The commercial insulation that served as the control material in Example 1, flared, but not as badly as the first commercial insulation. Char was observed over approximately 75% of the surface of the 5 gram mound of this insulation material. The insulation material of the present invention used in this experiment burned only in the immediate vicinity of the flaming match. There was no flaring and only approximately 10% of the surface of the 5 gram mound was observed to have charred. As concerns the material of the present invention, its condition observed subsequent to heating it at 200° F. for two hours was substantially comparable to its condition before such heating was initiated.

EXAMPLE FIVE

A pan having dimensions 3"×3"×6" was three quarters filled with shredded paper insulation to which a retardant composition was applied consisting of one part urea, one part ammonium orthophosphate and one part mono-calcium orthophosphate.

A Weller soldering iron was heated and thrust into the center of the mass of insulation. After three or four minutes smoke was emitted and charring had occurred. When the iron was removed a layer of carbonaceous material had formed around the iron. Substantially all smouldering within the mass of insulation had ceased.

The same steps were taken with a shredded paper insulation with a commercial ammonium sulfate fire retardant. Smouldering afterglow propagated outwardly from the iron and had to be doused with water. There was no carbonaceous layer.

The same steps were then taken with shredded paper which was untreated with any retardant. This material was carbonized but afterglow continued.

EXAMPLE 6

Five grams of triple super phosphate were ground with a mortar and pestle into a fine powder. One gram of powdered super triple phosphate was mixed with four grams of shredded cellulose made from newspaper. The materials were mixed by shaking in a one pound coffee can with a plastic lid for 15 seconds. The mixture was then removed and three grams of the mixture were spread into a flattened pile. A burning book match was then placed upon the flattened pile.

The cellulose insulation ignited and produced a char. The flame progressed to about 80% of the surface and was extinguished.

EXAMPLE 7

The same procedures as described in Example 6 were carried out using powdered triple super phosphate and powdered urea. Two-thirds gram of powdered urea was intimately mixed with one-third gram of powdered triple super phosphate. One gram of this mixture was added to four grams of shredded paper and mixed as described above. Two grams of the mixture were spread in a flattened pile and then a burning book match was laid upon them.

The results were that the area charred was limited to that in the immediate area of the match flame. The match was extinguished after it was about half burned.

EXAMPLE 8

The same procedure was carried out as described in Example 7 except that the two-thirds gram of powdered urea and one-third gram of powdered triple super phosphate were not premixed. The powders were instead added separately to the mixing can and five grams of shredded paper insulation was also added to the can. After shaking the can for 15 seconds to mix the components, two grams of the material were again spread into a flat pile and a lighted book match was laid upon the pile.

The results were that the cellulose insulation and the fire retardant chemicals burned completely. Consequently the urea alone and the triple super phosphate alone in the above quantities do not provide adequate flame retardancy.

EXAMPLE 9

An experiment was conducted to determine the optimum calcium carbonate proportion in a formulation having two parts urea, one part diammonium phosphate and three parts triple super phosphate. In addition to these constituents, a first sample included one part calcium carbonate, a second sample included 1.5 parts calcium carbonate and a third sample included 0.75 parts calcium carbonate.

Each of these three samples were mixed with shredded paper insulation so that the total fire retardant chemical represented approximately 23% of the total weight. Portions of each of these samples were then exposed to heating to simulate the drying conditions in an attic. The samples were exposed to a 250 watt infrared heat lamp which was suspended 10 inches above the samples. A portion of each sample was not exposed to the heat lamp, a second portion of each sample was exposed for 20 minutes and a third portion of each sample was exposed for 30 minutes.

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L13	(amphoteric same edta) and l4	2	L13
L12	(amphoteric same edta) and l3	16	L12
L11	(amphoteric same edta) and l2	19	L11
L10	L9 and amphoteric	7	L10
L9	l7 not l8	21	L9
L8	(edta)[ab,ti] and ((water or aqueous) same (polymer or copolymer or resin or binder))[ab,ti] and (524 or 523)/$.ccls.	2	L8
L7	(edta)[ab,ti] and ((water or aqueous) same (polymer or copolymer or resin or binder))[ab,ti]	23	L7
L6	(edta)[ab,ti,clm] and ((water or aqueous) same (polymer or copolymer or resin or binder))[ab,ti]	79	L6
L5	(edta)[ab,ti,clm] and ((water or aqueous) same (polymer or copolymer or resin or binder))[ab,ti,clm]	149	L5
L4	(edta)[ab,ti,clm] and ((water or aqueous) and (polymer or copolymer or resin or binder))[ab,ti,clm]	240	L4
L3	(edta)[ab,ti,clm] and (water or aqueous) and (polymer or copolymer or resin or binder)	861	L3
L2	(edta)[ab,ti,clm]	1770	L2
L1	edta	44710	L1

END OF SEARCH HISTORY